

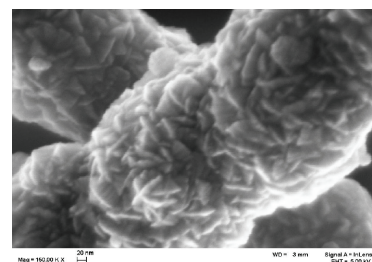
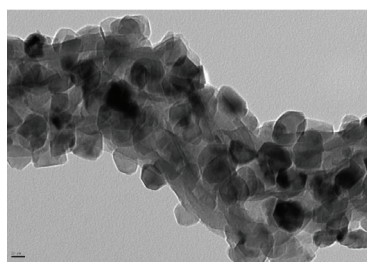
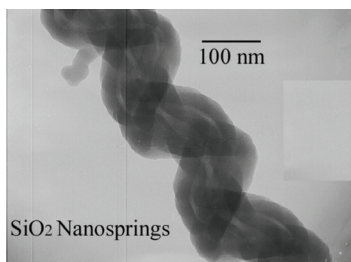
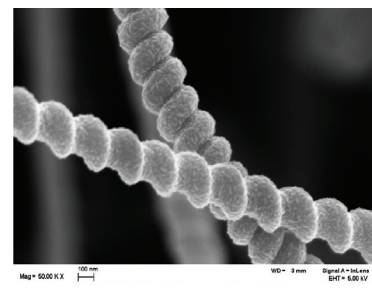
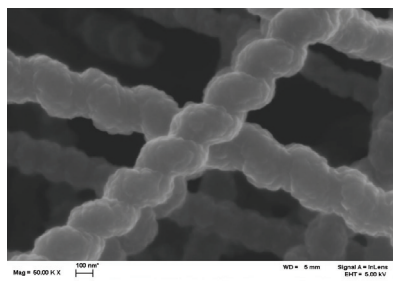
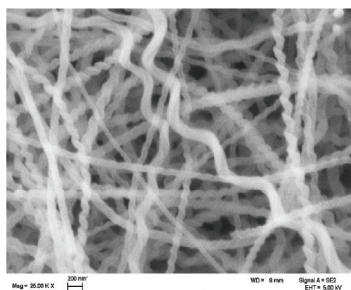
metals · inorganics · organometallics · catalysts · ligands · custom synthesis · cGMP facilities · nanomaterials

Silica Nanosprings™ are grown in a proprietary atmospheric CVD process at temperatures ranging from 350-1000°C in a tubular flow furnace. Gold is sputtered onto the support substrate to a thickness of 15-90nm and a rate of 10nm min⁻¹ prior to deposition of the silica nanosprings to provide a suitable surface for attachment. The absorption of the gold surface plasmon provides the reddish color of the silica nanosprings. Typically, an average of 8 intertwined nanowires make up one nanospring. Once the nanosprings are coated with titania or zinc oxide they appear white.

Some potential applications for nanosprings include chemical and biological sensors, hydrogen storage, nano electromechanical systems (NEMS) and catalyst supports, among others. The nanospring deposition process can be tailored for a wide variety of substrates including integrated circuits when the low temperature range is used eg 350°C.

	SiO ₂ Nanosprings™ attached to substrate	SiO ₂ Nanosprings™ coated with TiO ₂ attached to substrate	SiO ₂ Nanosprings™ coated with ZnO attached to substrate
Glass Slide Substrate (2.5 x 7.5cm)	14-6014	14-6034	14-6054
Al foil substrate (3.5 x 8cm)	14-6010	14-6030	14-6050
Fiber Glass Substrate (3.5 x 8cm)	14-6012	14-6032	14-6052

NANOSPRING™ Mass:	0.5±0.09 mg/cm ²	0.5±0.09 mg/cm ²	0.5±0.09 mg/cm ²
Coating Mass:	NA	0.5±0.05mg/cm ²	3.0±0.5mg/cm ²
Total Mass:	NA	1.0±0.1mg/cm ²	3.6±0.5mg/cm ²
Color and form:	reddish white	white	white to beige
Structure:	Amorphous. Multiple springs form a larger Nanospring™.	Crystalline on amorphous silica Nanospring™.	Crystalline on amorphous silica Nanospring™.
Wire Diameter:	87.1±45.2nm	163±49.6nm	201.6±52nm
Coil Diameter:	191.8±43.6nm	254±60.8nm	279.7±49nm
Coil Pitch:	315.5±110.5nm	277±100.3nm	298.5±115nm
Surface Area:	350m ² /g		
Crystal size:		32.6±8.6 x 36.7±8.1nm	23±8 x 50.7±16nm



Visit www.strem.com for new product information and searchable catalog.

Strem Chemicals, Inc.
7 Mulliken Way
Newburyport, MA 01950-4098
U.S.A.
Tel.: (978) 499-1600
Fax: (978) 465-3104
Email: info@strem.com

Strem Chemicals, Inc.
15, rue de l'Atome
Zone Industrielle
67800 BISCHHEIM France
Tel.: (33) 03 88 62 52 60
Fax: (33) 03 88 62 26 81
Email: info.europe@strem.com

Strem Chemicals, Inc.
Postfach 1215
77672 KEHL
Germany
Telefon: 0 78 51/ 7 58 79
Email: info.europe@strem.com

Strem Chemicals UK, Ltd.
41 Hills Road
Cambridge
England CB2 1NT
Tel.: 0845 643 7263
Fax: 01223 368021
Email: enquiries@strem.co.uk

Sold under license from **GoNano** for research purposes only. US 11-993,452 & PCT WO2007/002369A3

Selected references:

- [1] V. V. R. Sai, Devananda Gangadean, Ishwar Niraula, Jamie M. F. Jabal, Giancarlo Corti, D. N. McIlroy, D. Eric Aston, Josh R. Branan and Patrick J. Hrdlicka, "Silica Nanosprings Coated with Noble Metal Nanoparticles: Highly Active SERS Substrates", *J. Phys. Chem. C* 2011, 115, 453-459.
- [2] K.F. Schilke, K.L. Wilson, T. Cantrell, G. Corti, D.N. McIlroy, and C. Kelly, "A novel enzymatic microreactor with *Aspergillus oryzae* β -galactosidase immobilized on silicon dioxide nanosprings," *Biotechnology Progress*, 2010, 26, 1597-1605.
- [3] Y.P. Timalsina, D. Oriero, T. Cantrell, T. Prakash, J. Branan, D.E. Aston, K. Noren, J.J. Nagler, S. Rastogi, D.N. McIlroy, and G. Corti, "Characterization of a vertically aligned silica nanospring-based sensor by alternating current impedance spectroscopy," *Journal of Micromechanics and Microengineering*, vol. 20, 2010, p. 095005.
- [4] L. Wang, D. Major, P. Paga, D. Zhang, M.G. Norton, and D.N. McIlroy, "High yield synthesis and lithography of silica-based nanospring mats," *Nanotechnology*, vol. 17, 2006, pp. S298-S303.
- [5] G. Corti, L. Wang, D. Major, J. Jabal, L. Branan, J. Nagler, E. Aston, G. Norton, and D. McIlroy, "Mater. Res. Soc. Symp. Proc.," MRS, 2007, pp. V05-03.
- [6] D.N. McIlroy, A. Alkhateeb, D. Zhang, D.E. Aston, A.C. Marcy, and M.G. Norton, "Nanospring formation—unexpected catalyst mediated growth," *Journal of Physics: Condensed Matter*, vol. 16, 2004, pp. R415-R440.
- [7] D.N. McIlroy, D. Zhang, Y. Kranov, and M.G. Norton, "Nanosprings," *Applied Physics Letters*, vol. 79, 2001, p. 1540.

Visit www.strem.com for new product information and searchable catalog.

Strem Chemicals, Inc.
7 Mulliken Way
Newburyport, MA 01950-4098
U.S.A.
Tel.: (978) 499-1600
Fax: (978) 465-3104
Email: info@strem.com

Strem Chemicals, Inc.
15, rue de l'Atome
Zone Industrielle
67800 BISCHHEIM France
Tel.: (33) 03 88 62 52 60
Fax: (33) 03 88 62 26 81
Email: info.europe@strem.com

Strem Chemicals, Inc.
Postfach 1215
77672 KEHL
Germany
Telefon: 0 78 51/ 7 58 79
Email: info.europe@strem.com

Strem Chemicals UK, Ltd.
41 Hills Road
Cambridge
England CB2 1NT
Tel.: 0845 643 7263
Fax: 01223 368021
Email: enquiries@strem.co.uk